Laboratory Techniques

This department in TEXTILE RESEARCH JOURNAL *is a special section for notes on laboratory techniques peculiar to textile testing and research which would ordinarily not be of sufficient importance or length for publication as a formal* JOURNAL *paper.*

It is intended to encourage free exchange of helpful modifications of existing tests or apparatus for special purposes and to bring to light newly developed methods and devices. The time spent in standardizing present tests and in developing new ones for the multitude of problems facing the textile technologist would be considerably reduced if information of this sort were made available. Therefore the JOURNAL *invites contributions from its readers.*

In accordance with the established practice, all papers will be submitted to competent judges before being accepted for publication.

Simplified Method for Evaluating the Dimensional Stability of Tubular Knit Fabrics

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CURRENT shrinkage measurement specifications require that after extraction laundered specimens be dried flat in an oven, following which they are sprayed and pressed before remeasuring.

In connection with these procedures, two major causes of excessive variation have been noted: (1) inability to dry without distorting the specimen, and (2) the dependence of results on individual manipulative techniques in measurement. An estimate of the variation of the currently accepted measuring method † is given in Table I. Measurements were made of the shrinkage of a medium-weight ribbed underwear tubing, knit from a single 20s combed cotton yarn, weighing approximately 6.5 ounces per square yard. A standard cotton-laundering procedure was used.†

Two possible means of reducing this great variation are suggested: (1) by effecting perfectly tensionless drying through use of a rotary drier, and (2) by measuring the fabrics after application of constant light tension across the width of the fabric to eliminate wrinkles.

Experiments were made on three typical rib-knit constructions representing a range of weights and yarn sizes within which most underwear fabrics would fall. A summary of the characteristics of the three constructions is given in Table II.

Specimens from each sample were randomized with respect to position along the length of the respective bolts and then were divided into two groups. One group was measured flat ‡ in the conventional manner and the other was measured using a tension (bar) device. Both groups were laundered and then dried in a rotary drier for 30 minutes at 130°F. The specimens were then allowed to attain moisture equilibrium under standard conditions of temperature and R.H. Measurements before and after laundering were made by three individuals to obtain an indication of personal variations.

The increased precision effected by the substitution of rotary-drying for oven-drying was clearly significant. For example, the standard deviations listed in Table I, which were 1.8 percent for the wales and 2.8 percent for the courses when conventional oven-drying was employed, were reduced to 0.6 percent for the wales and 0.4 percent for the courses (in samples of the same weight) after rotary-drying (Table III).

Measurements after the application of tension were accomplished by means of the bar device illustrated

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† "Textiles: General Specifications, Test Methods," CCC-T-191a (Section XIV), 1945.

‡ Accomplished by measuring the actual width of the specimens at four positions and the distance between three sets of 18-inch markers in the length. All measurements were made after the specimens had attained moisture equilibrium in an atmosphere of 65% R.H. at 70°F.

TABLE I. SHRINKAGE OF MEDIUM-WEIGHT KNIT FABRIC MEASURED AFTER OVEN-DRYING

Average shrinkage (%)		Standard deviation (%)	
Wales	Courses	Wales	Courses
12.7	−4.3	1.8	2.8

NOTE: Averages are based upon 10 specimens; minus sign indicates elongation.

TABLE III. SHRINKAGE OF KNIT FABRICS MEASURED AFTER ROTARY-DRYING

Fabric	Average shrinkage (%) Wales	Average shrinkage (%) Courses	Standard deviation (%) Wales	Standard deviation (%) Courses
Lightweight	18.3	0.4	0.9	0.6
Medium-weight	16.0	−1.0	0.6	0.4
Heavyweight	15.2	−6.4	0.8	1.0

in Figure 1. With the tubing suspended from a bar supported by the uprights, a second bar was inserted into the tubing and lowered gradually to the bottom, where it provided an even tension across the width of the material. The length of the suspended tubing was then determined by measuring the distance between 18-inch markers (three pairs) while the width dimensions were taken at four places, measured from the top of the upper bar to the bottom of the lower bar. After initial measuring, the specimens were laundered with no effort being made to open or spread the material before it was placed in the washer, so as to avoid excessive distortion.

With rotary-drying clearly established as a necessary feature of the test method, the F test was used to compare the variability of the two measuring techniques and the coefficients of variation were used to compute the average sample size required for a precision in measurement of 95 percent and an accuracy of approximately 5 percent.

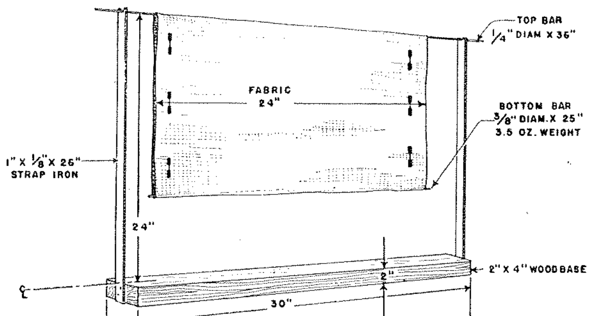

FIG. 1. *Bar device for measuring the shrinkage of knit tubing.*

TABLE II. PHYSICAL CHARACTERISTICS OF KNIT GOODS

Fabric	Weight (oz./sq. yd.)	Yarn no.	Wales	Courses	Knit	Yarn
Lightweight	5.2	1/30s	30	34	Rib 1×1	Combed
Medium-weight	6.5	1/20s	24	30	Rib 1×1	Combed
Heavyweight	10.6	1/10s	20	24	Rib 1×1	Combed

TABLE IV. VARIANCES SHOWING PRECISION OF TWO METHODS OF MEASURING THREE WEIGHTS OF COTTON UNDERWEAR

Method	Lightweight Wales	Lightweight Courses	Medium-weight Wales	Medium-weight Courses	Heavyweight Wales	Heavyweight Courses
Bar	0.015	0.008	0.017	0.006	0.015	0.009
Flat	0.015	0.014	0.010	0.029	0.012	0.019
Ratio: $\frac{\text{Flat}}{\text{Bar}}$	1.00	1.75*	0.588	4.83*	0.80	2.17*

* Significant difference in precision.

TABLE V. COEFFICIENTS OF VARIATION IN MEASURING SHRINKAGE OF UNDERWEAR BY THE BAR METHOD

	Light-weight	Medium-weight	Heavy-weight
Wales	4.9	4.3	3.5
Courses	—	—	9.0

Table IV lists the pooled variances of the three measurements of the wales and four measurements of the courses on each of 10 laundered specimens using the bar and the flat methods. The ratios of the variances were utilized to test for differences in consistency between the methods. No significant difference exists between the two in measuring the wales, but the bar is significantly more precise in the measurements of the courses.

Table V lists the coefficients of variation of the average shrinkage measurements by the bar method. Since the average shrinkage measurements of the courses were less than 2 percent for the light- and medium-weight fabrics, regardless of operator or method, their variability was disregarded in these weights. However, the average shrinkage in the heavyweight fabric for the courses was − 6.2 percent for the bar method, with an average coefficient of variation of 9 percent. Computation of the sample size for estimating the average shrinkage of the courses is based on the variability of the heavyweight sample alone.

Using the procedures recommended by the American Society for Testing Materials,* it was deter-

* A.S.T.M. Standards on Textile Materials—Appendix VI, 1943.

mined that if the average wales shrinkages of 5 specimens were taken, the sample average would be within 5 percent of the true average 95 times in 100.

Owing to the greater variability in shrinkage measurements of the courses, it would be necessary to allow for an 8-percent tolerance limit if it were desirable to take 5 specimens with the same probability. It would be necessary to take 15 specimens in the latter case if a 5-percent tolerance limit were used.

It is apparent from the above discussion and analysis that a reliable method of evaluating the shrinkage of tubular knit goods may be had by substituting rotary-drying for oven-drying in the test procedure and utilizing a bar device to eliminate subjective measuring errors.

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